EPA Region 7 TMDL Review

TMDL ID:	KS-LA-05-048801_LM	**Waterbody ID:**	KS-LA-05-LM048801
Waterbody Name:	ANTHONY CITY LAKE		
Tributary:	Spring Creek		
Pollutant:	EUTROPHICATION, SILTATION		
State:	KS	**HUC:**	11060005
BASIN:	Chikaskia Basin		
Submittal Date:	1/9/2007		
Approved:	Yes		

Submittal Letter

State submittal letter indicates final TMDL(s) for specific pollutant(s)/water(s) were adopted by the state, and submitted to EPA for approval under section 303(d) of the Clean Water Act.

The TMDL for Anthony City Lake was formally submitted by the Kansas Department of Health and Environment (KDHE) in a letter received by EPA on December 11, 2006. The public comments and KDHEs response to those comments were formally submitted by KDHE in a letter received by EPA on January 9, 2007. Revisions to the TMDL were received by email and dated February 26, 2007. Subsequent revisions addressing dissolved oxygen (DO) and pH were received June 4, 2007 and June 18, 2007.

Water Quality Standards Attainment

The water body's loading capacity for the applicable pollutant is identified and the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources is described. TMDL and associated allocations are set at levels adequate to result in attainment of applicable water quality standards.

The loading capacity (LC) is set through the use of a lake eutrophication model (BATHTUB) to target the annual amount of total phosphorus (TP) and total nitrogen (TN) that Anthony City Lake can receive to meet its designated uses. To address the identified pollutants (siltation and eutrophication), a chlorophyll-a (Chla) concentration of 12 ug/L was used to link the concentration of TP and TN to the quantity of eutrophication. Chla of 12 ug/L is a target for primary contact recreation. EPA agrees this is an appropriate translator for this TMDL. The desired endpoints under this TMDL will be refined based on additional monitoring and evaluation. A concentration of 4 mg/L total suspended solids (TSS) was used to link clarity to a Secchi depth (SD) of 0.7m. A sediment load was also calculated. Low DO concentrations frequently occur when the lake is turbid. Lake Anthony is a shallow lake. The appearance of high pH levels coincides with high Chla conditions when the lake is clear. The impairment of the low DO and high pH conditions will be addressed in this eutrophication TMDL. Water quality standards (WQS) should be attained.

Because lake conditions represent responses to environmental load occurring over an extended period of time, expression of the load as an average annual value is the preferred approach found in current scientific limnological literature. Expressing the TMDL in daily time steps would mislead the reader by implying a daily response to change in daily loading. Although a short-term response after a precipitation event could have localized lake effects, Kansas assesses the condition of their lakes over the growing season. The growing season mean is affected by factors such as the following: internal lake nutrient loading, water residence time, wind action, and the interaction between light penetration, nutrients, turbidity, sediment load, and algal response.

Numeric Target(s)

Submittal describes applicable water quality standards, including beneficial uses, applicable numeric and/or narrative criteria. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, site specific if possible, was developed from a narrative criterion and a description of the process used to derive the target is included in the submittal.

Designated uses of Anthony City Lake are:
Primary Contact Recreation
Expected Aquatic Life Support
Food Procurement Use

WQS-
Suspended solids - Narrative: Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat or other factor related to the survival and propagation of aquatic or semi- aquatic or terrestrial wildlife (KAR 28-16-28e(c)(2)(D).

Nutrients – Narratives: The introduction of plant nutrients into streams, lakes or wetland from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life (KAR 28-16-28e(c)(2)(A).

In surface waters designated for the Aquatic Life Support, the concentrations of DO shall not be lowered by the influence of artificial sources of pollution: DO: 5 mg/L; and the pH range outside the zone of initial dilution: 6.5-8.5 (K.A.R28-16-28e(d), Table 1g).

Eutrophication:
Chla water quality endpoint for primary recreation is 12 ug/L Chla.
Chla water quality endpoint for secondary recreation is 20 ug/L Chla.

Current conditions show the average Chla at 32 ug/L Chla. High Chla appear when turbidity values were low (<40 NTU). Turbidity values have a strong negative relationship with SD readings. Average turbidity values and SD reading are 92 NTU and 0.16 m, respectively. TP averages 274 ug/L. Lake Anthony's nutrient values were over the trophic criteria proposed by EPA. Chla/TP index values and TN:TP ratios all suggest that nitrogen and light appear to be the primary limiting factor.

The state deems these conditions as not complying with their narrative WQS. The State of Kansas does not have numeric criterion for nutrients in their WQS. The lake exceeded the narrative WQS which states that "water shall be free from" aesthetically objectionable conditions.

Based on a lake eutrophication model (BATHTUB), 70% of the nutrient reduction is required from the current watershed condition. Additionally, a SD of 0.7m was concurrently used for the desired lake clarity. "Brown" scores were used as a guideline to link siltation as measured by SD. TSS shows a relationship to SD. The target TSS and SD are 4 mg/L and 0.7m, respectively, suggesting a 94% TSS reduction is necessary to reach the SD 0.7m endpoint.

Because of decomposition and mineralization of organic matter, the lake typically has lower pH and DO values and higher ammonia and nitrate/nitrite concentrations. The DO decline rate was calculated to be 1.60 mg/L per meter. However, when less rainfall occurred in the watershed and/or the lake was calm, the sunlight readily penetrated and algal production reached maximum. As a result, higher DO and pH values and lower nutrients appeared commonly.

Numeric Target(s) and Pollutant(s) of concern

An explanation and analytical basis for expressing the TMDL through surrogate measures (e.g., parameters such as percent fines and turbidity for sediment impairments, or chlorophyll-a and phosphorus loadings for excess algae) is provided, if applicable. For each identified pollutant, the submittal describes analytical basis for conclusions, allocations and margin of safety that do not exceed the load capacity.

The State of Kansas does not have numeric criterion for nutrients and suspended solids in their WQS.

The siltation impairment is linked through clarity to a TSS concentration of 4 mg/L and a SD of 0.7m. A sediment load of 160 tons/yr was calculated based on the TSS concentration of 4 mg/L.

DO concentrations should exceed 5 mg/L for the entire water column of the lake. Levels of pH should also return at or below 8.5 (to the acceptable range of 6.5-8.5).

A concentration of 12 ug/L Chla is needed to attain the primary contact recreation use and a concentration of 20 ug/L Chla is needed to attain a secondary contact recreation use. Based on a lake eutrophication model (BATHTUB), a 70% load reduction for nutrients (TN & TP) is required to reach the endpoint. This translates to a load of 6,611 lbs/yr TN and 711 lbs/yr TP. This reduction of TP and TN loading is an established link in the reduction of Chla concentrations. Chla concentrations are linked to eutrophication through trophic indices.

Source Analysis

Important assumptions made in developing the TMDL, such as assumed distribution of land use in the watershed, population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources, are described. Point, non point and background sources of pollutants of concern are described, including magnitude and location of the sources. Submittal demonstrates all significant sources have been considered.

The Chaparral High School is the only state permitted facility (M-AR04-NO02) within the watershed. The facility has a non-discharging one-cell lagoon system that may contribute nutrient load to Lake Anthony via Spring Creek under extreme precipitation events (stream flows associated with such events are typically exceeded only 1 - 5 % of the time).

Only one confined cattle feedlot operation (Permit No: A-ARHP-BA03) is certified within the watershed. This beef feedlot operation is located at the central area of the watershed, just about 1.5 miles south-west from Harper City. The facility consists of 7 acres of dirt lots which drain onto adjacent cropland. The maximum allowable animal number for this facility is 450 head.

According to the 2000 census data from the U.S Census Bureau, the population of the entire watershed was 250 people, and therefore the watershed population density is relatively high (12 people/sq. mile) when compared to the density of Harvey County (8 people/sq. mile). Because this watershed is a rural, agricultural area, many of the farm houses are not connected in a public sewer system, failing onsite systems may contribute significant nutrient loadings and aggravate eutrophication problems under the low flow conditions.

About 70% of the watershed produces runoff even under relative low (1.5"/hr) potential runoff conditions.

Eight percent of 30- m riparian buffer areas are covered by forest/woodland and about 50% of the riparian areas are occupied by either CRP, or native or non-native prairie; leaf and grass litter may be contributing to the nutrient loading. The atmospheric phosphorus and geological formations (i.e., soil and bedrock) may also contribute to phosphorus loads. Because Lake Anthony is a small shallow lake, nutrient cycling of the sediment (from wind mixing and bottom feeding fish) is likely contributing available nutrients to the lake for algal uptake. Because the orientation of the lake is parallel to the prevailing wind directions, some resuspension of sediment may contribute turbidity to the lake. Likewise, bottom feeding fish may also re-suspend the sediment and thus contribute some turbidity. However, as compared to wind- induced turbidity, this biological (fish) turbidity is likely to be minor.

All sources of siltation and eutrophication have been considered.

Allocation

Submittal identifies appropriate wasteload allocations for point, and load allocations for nonpoint sources. If no point sources are present the wasteload allocation is zero. If no nonpoint sources are present, the load allocation is zero.

The TMDL document set a TP allocation at 711 lbs/yr, TN allocation of 6,611 lbs/yr, a sediment allocation of 160 tons/yr, a TSS allocation of 4 mg/L, a Chla allocation of 12 ug/L, and a SD allocation of 0.7m.

To translate the long-term averages to maximum daily values, the approach used is described in the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001.) The Maximum Daily Load (MDL) equals the Long Term Average (LTA) * exp (z*sigma - 0.5*sigma^2.) Sediment, nitrogen, and phosphorus are expected to have large coefficients of variation (CV).

WLA Comment

WLA is zero.

LA Comment

The load allocation (LA) of TP and TN for this TMDL is 640 lbs/yr (2.72 lbs/day) and 5,950 lbs/yr (24.3 lbs/day), respectively. A 70% nutrient reduction is required from the current watershed conditions. This reduction of TP and TN loading will also reduce Chla concentrations.

The Primary Contact Recreation Use target of 12 ug/L Chla concentration is expected to attain the impaired aquatic life use.

The LA to nonpoint sources for siltation is 144 tons of sediment delivered to the lake. To meet the desired water clarity in the lake of 0.7m SD, a 94% TSS reduction is required to reach the endpoint. This results in a target of 4 mg/L TSS and a sediment load of 144 tons/yr (0.68 tons/day).

Margin of Safety

Submittal describes explicit and/or implicit margin of safety for each pollutant. If the MOS is implicit, the conservative assumptions in the analysis for the MOS are described. If the MOS is explicit, the loadings set aside for the MOS are identified and a rationale for selecting the value for the MOS is provided.

The MOS is explicit and established by setting TSS allocations for the primary source of sediment to Anthony City Lake at an annual rate of 16 tons (10%) taken from the total load to ensure that adequate load reduction occurs to meet the endpoint (0.07 tons/day). For nutrients, the explicit MOS will be 661 lbs/yr and 71 lbs/yr or TN and TP, respectively (2.7 and 0.3 lbs/day).

Seasonal Variation and Critical Conditions

Submittal describes the method for accounting for seasonal variation and critical conditions in the TMDL(s).

This TMDL was developed based on Chla, TSS, and sediment contributions to generalized lake conditions. The annual targets should result in WQS attainment regardless of the season.

Public Participation

Submittal describes public notice and public comment opportunity, and explains how the public comments were considered in the final TMDL(s).

Public Meetings: A meeting was held at the City of Anthony on August 9 2006 to discuss Lake Anthony's TMDLs and watershed management plans. Interest groups included the city, Natural Resources Conservation Services, Lake Anthony Board, and Sunflower RC & D area, Inc. An active Internet site was established at http://www.kdheks.gov/tmdl/public.htm to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Lower Arkansas Basin.

Public Hearing: A Public Hearing on the TMDL of the Lower Arkansas Basin was held at the Kansas Department of Transportation Building, Hutchinson, KS on September 13, 2006.

Basin Advisory Committee: The Lower Arkansas Advisory Committee met to discuss the TMDLs in the basin on March 8, 2006.

Comments and the KDHE responses to the comments were formally submitted to EPA in a letter dated January 9, 2007.

Monitoring Plan for TMDL(s) Under Phased Approach

The TMDL identifies the monitoring plan that describes the additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of WQS, and a schedule for considering revisions to the TMDL(s) (where phased approach is used).

KDHE will continue its 4-yr sampling schedule in order to assess the impairment that drives this TMDL. Based on that sampling, the priority status of 303(d) listing will be evaluated in 2012. Should impaired status be verified, the desired endpoints under this TMDL will be refined and direct more intensive sampling will need to be conducted during the growing season over the period 2010-2012 to assess progress in this TMDL's implementation.

Reasonable assurance

Reasonable assurance only applies when reductions in nonpoint source loading is required to meet the prescribed waste load allocations.

There is only one non-discharging point source in the watershed with a WLA of zero. Therefore, reasonable assurances are not required. Reasonable assurance includes numerous authorities and funding through the Kansas Water Plan.